Back-to-Basics

Axial Thrust Position Monitoring - Part 1

Axial thrust position monitoring on turbomachinery is one of the machine's most important protective systems. Other machine malfunction modes can be equally catastrophic, but the deterioration and failure of a thrust bearing can occur with very little warning, within an extremely short period of time, and can lead to total destruction of the machine. Fortunately, the measurement technique required to provide this protection is straightforward. Unfortunately, the complete monitoring system may become useless if errors are made during installation.

This article (Part 1) will describe the most important installation considerations, including: (1) the concept of cold and hot float zones and (2) the relationship between the linear range of the proximity probe transducer system and the range of potential shaft axial position change.

Part 2 of this article, to be published in the next issue of *Orbit*, will address the relationship between the monitor readout and the position of the shaft (thrust collar) relative to the thrust bearing clearance. Part 2 will also offer guidelines on establishing monitor alarm set points.

Neither part of this article will describe the components of the monitoring system, nor explain how the system functions. That information is thoroughly presented in published literature.

Float Zones: cold vs. hot

The float zone is defined as the normal allowable movement of the thrust collar within the thrust bearing clearance. The "cold" float zone (Figure 1) is measured when the machine is at rest and cold (ambient temperature). However, this float zone will increase when the machine is at full load and operating speed. The change is due to the higher (operating) load on the thrust bearing. Other contributing factors are thermal expansion, springiness of the thrust bearing assembly, thrust pad deflection and squeezing of the oil film.

Thus, with the machine under full operating conditions, there is a "hot float zone" which is typically larger than the cold float zone by a significant amount. The example in Figure 1 shows a machine with a cold float zone of 16 mils (0.4 mm), from a probe gap of 42 to 58 mils, with corresponding Proximitor® outputs of −8.4 and −11.6 volts dc, respectively. The hot float zone is 24 mils (0.6 mm), from a probe gap of 38 to 62 mils (−7.6 and −12.4 Vdc, respectively). This represents an increase of 50 percent, which is not uncommon.

Too often, inexperienced users of axial position monitoring systems do not consider the change from cold to hot float zone. They will adjust the alert (first level) alarm to represent thrust collar-to-bearing contact, based on their measurement of the (cold) float zone when the machine was down. When the float zone expands, this alert set point represents a thrust collar position well within the bearing clearance, not in contact with the bearing. Thus, a change in shaft position which reaches this set point will cause a false alarm in the monitoring system.

There are two ways to avoid this type of false alarm. First, recognize the difference between cold and hot float zones, and allow for this when establishing monitor alarm set points. Second, adjust the alert alarm set point so that it represents 5 to 10 mils (125 to 250 µm) of babbitt wear. Then adjust the danger alarm set point so that it represents an *additional* 10 to 20 mils (250 to 500 µm) of wear beyond the alert level.

False alarms could occur even after allowing for the hot float zone. This is possible if (1) the alert alarm is adjusted too close to the surface of the bearing, (2) the hot float zone allowance is not enough or (3) a small error is made in adjusting the probe. After all, the objective of axial position monitoring is not necessarily to save the bearing from wear, but to save

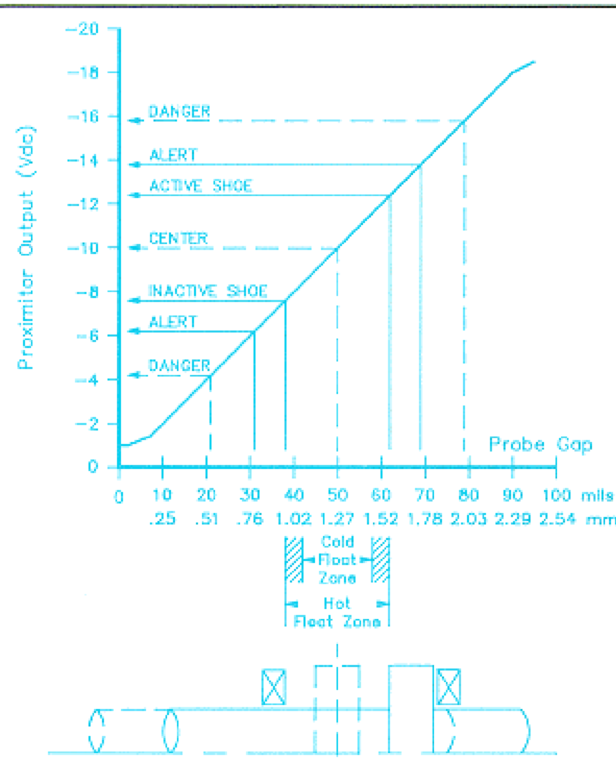

Figure 1
Relationship between transducer linear range and rotor position relative to thrust bearing

the machine from a severe axial rub and potential destruction.

In fact, some thrust bearing wear is even desirable from a monitoring standpoint. If a thrust position monitor indicates an alarm, and inspection reveals no damage to the bearing, then the operators (and everyone else including *the plant manager!)* will lose confidence in the monitoring system. Most machines are designed with thrust bearings which can sustain *some* babbitt loss long before the rotor is in danger of an axial rub. Therefore, it is reasonable to allow for *some* babbitt loss to occur before the first level of monitor alarm is generated.

In order to determine the cold vs. hot float zones on a particular machine, consult the machine manufacturer. This information can be compared to actual operating experience in order to refine the measurement.

Transducer range vs. shaft position range

The required axial position measurement range for any machine should cover the maximum allowable shaft position change in both directions in the thrust bearing. The shaft position range should include not only the clearance of the thrust bearing (cold and hot float zones), but also the allowable babbitt wear on both sides of the bearing (active and inactive).

The machine in Figure 1 has a thrust bearing clearance (hot float zone) of 24 mils (0.6 mm). In addition, 17 mils (0.4 mm) of babbitt wear is allowed on *each* side of the bearing before the danger set point is reached. Thus, the "rotor position range" (the total allowable rotor position change for the machine) is 58 mils (1.4 mm). The figure also shows the transducer's linear range to be significantly greater than the rotor position range. This situation is recommended for all axial position monitoring installations. In fact, the more the transducer's range exceeds the rotor position range, the easier it is to install the system correctly.

If the transducer's linear range is only large enough to cover the total anticipated rotor position range, then the installation of the probe at exactly the right gap distance from the shaft becomes difficult, if not impossible.

For example, if the transducer's linear range were 60 mils (1.5 mm), then it would be *imperative* to adjust the probe so that the center of the transducer's range equals the center of the rotor's (cold) float zone. In this example, the probe should be adjusted as close as possible to 58 mils (1.4 mm), or −11.8 Vdc, when the thrust collar is against the active side of the thrust bearing.

If, on the other hand, the transducer's linear range were 80 mils (2 mm), then the initial gap of 58 mils would not be so critical. With the thrust collar against the active side, the probe gap could be adjusted between 48 and 68 mils (1.2 and 1.7 mm). The system should operate correctly in any case.

For further information on axial thrust position monitoring, check the Thrust Monitoring box on the reader service card. ■

At Your Service

GARY HANDELIN has been appointed North American Sales Manager. Handelin will supervise all Bently Nevada Sales activities in the USA and Canada. He has been employed by Bently Nevada for more than 7 years. Handelin spent the last 4 years as project manager for one of the Company's most successful products, the Dynamic Data Manager. More recently, he was the project manager for SYSTEM 64, Bently Nevada's latest computerized machinery monitoring system. Handelin holds a Bachelor of Science degree in Electrical Engineering, a Masters in Business Administration, is a Registered Professional Engineer and has over 17 years of experience in Engineering, Engineering Management and Marketing.

LARRY QUEK has been named Manager for the Bently Nevada Corporation Liason Office in Beijing, Peoples Republic of China. Quek has been employed by Bently Nevada for over 4 years. He has been working as Product Service Manager in the Bently Nevada Singapore office for the last 2 years. Quek is the first direct Bently Nevada Corporation representative in the People's Republic of China (previously, Bently Nevada had a manufacturer's representative in China). Quek will now be responsible for the China and Hong Kong areas.

JOHN VAN ZWIENEN has been named Manager of Bently Nevada Sales and Services Singapore PTE, Ltd.

Van Zwienen has worked more than 8 years as a Bently Nevada Product Service representative at our Netherlands office. During this period he spent 2 years as temporary Service Manager in Singapore. Apart from Singapore, his current areas of responsibility are Indonesia, Malaysia, Bangladesh, Brunei, Burma, The Philippines and Thailand.

BOB YOUSSI has been named Southwestern District Sales Manager and is responsible for the Bently Nevada sales activities in Southern California, Southern Nevada, Arizona and New Mexico. He will be operating from the Bently Nevada office in Santa Ana, California. Youssi was hired as a Sales Representative for the San Diego, California area in 1981. In 1986, he was named Salesman of the Year, due to his outstanding performance. Youssi earned a Bachelor of Science degree in Marketing from Northern Illinois University.

STEVE FOLLMAR has been named Bently Nevada District Sales Manager, responsible for the Bently Nevada Sales activities in Northern Texas, Oklahoma, Kansas and Missouri. He will be operating from the Bently Nevada office in Houston, Texas.

Follmar began his career at Bently Nevada in 1978 as a Sales Representative in the Southern California area. In 1981, he was promoted to Southwestern District Sales Manager. Follmar earned his Bachelor of Business Administration degree from California State University at Fullerton.

RICK PUTNEY has been named Southeastern Regional Service Manager. Putney will be based at the Bently Nevada office in Marietta, Georgia. Putney was hired as a Field Technician in our Buffalo, New York office in 1978. He transferred to the Dublin, California office in 1980 and in 1983 was promoted to Product Service Coordinator. He moved to Broomall, Pennsylvania later that year as Product Service Coordinator. Putney earned his Associate in Applied Science degree (Electronics/Electronic Communications from State University of New York. ■